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1 Introduction

**common phenomenon:**

To a high degree we can identify speakers solely on the basis of their voice. (e.g. in telephone calls)

→ Every speaker has individual features in the acoustic signal of his/her voice.
1 Introduction

Most prominent interests of phonetics/linguistics:
What are the acoustic properties common to vowels, consonants, syllables, words, etc., etc.?

Less prominent interests:
What are the speaker specific acoustic characteristics of speech?
1 Introduction

When are speaker specific characteristics of importance?

When a person has to be identified on the basis of his her voice

- speaker identification: speaker is not-cooperative
  - forensic phonetics
- speaker verification: speaker is cooperative
  - e.g. automatic access systems
Forensic Phonetics:
Area of phonetics that deals with questions in which speaker identification is relevant to solving a crime.

Prominent cases:
• hoax calls to emergency numbers
• sexual harassment calls
• bank robberies in which robbers are masked but recorded
• telephone calls from kidnappers
• crimes (e.g. rapes) in darkness in which victim cannot see but hear the perpetrator
1 Introduction

Main Task (two points of view):
Find the sources of between- and within-speaker variability (inter- and intra-speaker variability)

**between-speaker variability:** necessary to judge whether two recordings are from different speakers

**within-speaker variability:** necessary to judge whether two recordings that sound different could be from the same speaker
1 Introduction

e.g.:
Given are two recordings. The speaker in recording a) has an average f0 of 120 Hz the speaker in recording b) has an average f0 of 160 Hz

**between-speaker variability:**
Is the f0 variation a result of organic differences between two different speakers?

**within-speaker variability:**
Is the f0 variation the result of the same speaker speaking under different emotional conditions, or disguising his/her voice?
Speaker variability

organic differences:
- Differences in the vocal tract length and shape
- Differences in size of larynx and vocal folds
- etc.

linguistic differences:
- Variation in accent/dialect
- Sociolinguistic variation (register)

paralinguistic variation:
- speaker is stressed, happy, sad, etc.

learned differences
1 Introduction

Main resources:

1. Forensic Linguistics:

2. International Association of Forensic Phonetics (IAFP)
   www.iafp.net
2 Sources of Variability

Voice Quality

Within-Speaker Variability

• *Can* change pitch and voice quality

Between-Speaker Variability

• *Cannot* change basic physiology, which limits ranges of pitch and voice qualities
• Pitch range and voice quality interact
2 Sources of Variability

Formant Frequencies

Within-Talker Variability

• *Can* change articulators (tongue and lip positions), which affect formant frequencies and create different phonemes

Between-Talker Variability

• *Cannot* greatly change length of vocal tract, which limits range of formant frequencies
2 Sources of Variability

Linguistic Experience

The way we produce phonemes and prosody are specified by our own childhood linguistic experience

Between-Talker Variability

• Different talkers have different acoustic realization of phonemes and prosody.

Within-Talker Variability

• Can this be disguised?
3 Areas of Forensic Phonetics

Speaker Identification

Expert-witness identification:
An expert witness uses his auditory phonetic skills as well as acoustic methods of speech signal analysis.

Naive speaker identification:
Voice identification of a phonetically naive ear witness.
3 Areas of Forensic Phonetics

Expert witness identification

Perceptual abilities
• Same basic perceptual ability to use naive abilities
• However, can use their ear training to be more aware of voice quality and within-category differences
• Can use knowledge of phonetics, phonology, and sociolinguistics to detect disguises and dialect leveling

Acoustic analysis
• Can verify perceptual impressions
• Can spot aspects of the voices that perception missed
3 Areas of Forensic Phonetics

Expert witness identification

Prominent cases

• Statement has to be made whether the voice of an accused matches the voice of a recording that has been made in the context of a crime.
3 Areas of Forensic Phonetics

Myth about expert witness identification

Voiceprints
  • Spectrograms are not like fingerprints

Higher-level formants and voice quality
  • Not necessary for speaker recognition, but may provide information in some cases
3 Areas of Forensic Phonetics

expert-witness identification

Inter and intra-variability are high and multi-dimensional.

→ it is difficult to identify a speaker with high security.
→ it is often easier to find proof for non-identity.

Even in cases of high possible identity one of the main tasks of the expert witness should be to inform the court about the limitations of forensic speaker identification methods (code of practice, IAFP).
3 Areas of Forensic Phonetics

Naive speaker identification

Ear witnesses of a crime are asked to identify a suspect on the basis of his/her voice.
"Colonel Lindbergh’s identification of the defendant by his voice was entitled to little weight" (State v. Hauptmann 1935, S. 825).
Ear witnesses of a crime are asked to identify a suspect on the basis of his/her voice.

**Today:**
Expert witness has to rate the ability of a naive listener whether he/she is able to identify a certain voice.

**Methodology: Voice line-up or voice parade**
Systematic presentation of voice stimuli of a suspect mixed with other voices in order to measure recognition performance of a naive ear witness.